

Information Quality, Human and Environmental Capital: Comparative Effects on Financial Performance in the Energy Sector of Developed and Developing Countries

ABSTRACT

Purpose- The present work aims to examine the human capital, and environmental and informational factors impact on financial performance in a sample of 169 multinational companies in the energy sector between 2016 and 2022.

Design/methodology/approach- This study employs random-effects generalized least squares (RE GLS) estimation with year and industry-fixed effects to analyse the determinants of the Gross Profit Margin.

Findings- The findings confirm that internal factors such as human resource management, compliance with best environmental practices, and high-quality financial reporting are critical value and financial success drivers in the energy sector. Moreover, the results indicate that institutional differences between developed and developing countries remain substantial, with the financial impact of environmental performance being notably weaker in emerging economies.

Originality-This study uniquely integrates human capital, environmental capital, and information quality into a single analytical model and thereby capturing their synergistic and conflicting interactions. Moreover, it employs a global and large multinational dataset, offering robust, generalizable insights across diverse institutional and cultural contexts, unlike prior work with narrower, often single-country scopes. The study also differentiates results between developed and emerging markets, enhancing its practical relevance.

Practical implications- Managers should prioritize investments in employee development, adopt sustainable practices, and ensure high-quality financial and non-financial reporting to achieve long-term profitability. Policymakers, investors, and other stakeholders should also recognize the value of these practices in promoting sustainable growth and resilience in an increasingly complex and scrutinized industry.

Keywords: Energy Sector, Earning Quality, HCE, Salary Gap, Professional Development, CO₂ Emissions, ESG controversies, Financial Performance.

1. INTRODUCTION

Energy constitutes a fundamental pillar of modern societies and economies, influencing economic, social, and political dynamics. As a key driver of technological and industrial development, the energy sector plays a crucial role in meeting the growing global demand for energy. Beyond its economic relevance, this sector is heavily dependent on natural resources and is among the main emitters of greenhouse gases (GHG) (Stavytskyy *et al.*, 2018), which has placed it under intense public scrutiny (Shahbaz *et al.*, 2020).

In light of the growing global concern for sustainable development, energy companies are under increasing pressure to achieve financial success while simultaneously meeting environmental and social objectives. Identifying the drivers of financial performance in such a critical sector is essential for fostering resilience, promoting sustainable practices, and aligning business operations with stakeholder expectations according International Energy Agency (IEA, 2024a). Although multiple internal and external factors influence profitability, recent research highlights the rising importance of intangible resources, particularly those linked to human capabilities, environmental stewardship, and information transparency, as central determinants of value creation in an increasingly complex and sustainability-driven industry.

This growing relevance of intangible forms of capital is the result of several converging forces: accelerating technological disruption, more stringent climate and environmental regulation, and heightened investors and stakeholder scrutiny of ESG performance (Eccles *et al.*, 2014). These conditions have shifted competitive advantage away from physical assets and towards resources that are knowledge-based, environmentally responsible, and information-driven. As a result, human, environmental, and informational capital have become strategic components shaping firms' financial outcomes.

Human capital substantially underpins energy firms' profitability and long-term value creation. A skilled, adaptable workforce facilitates the uptake of new technologies, enhances operational efficiency, and enables firms to meet evolving sustainability and regulatory requirements (Delgado-Verde *et al.*, 2016). Continuous training raises productivity, innovation and safety -critical in a high-risk sector (Leiponen, 2005)- and strengthens organizational legitimacy and stakeholder trust (Subramony *et al.*, 2018). Human capital thus forms the foundational capability on which energy companies rely to manage technological, environmental, and regulatory pressures.

Building on this foundation, environmental capital has become increasingly important for financial stability. Energy companies face operational disruptions, high compliance costs, and reputational risks associated with carbon-intense activities and environmental degradation (IEA, 2021). Managing emissions and environmental risks is now directly tied to competitive advantage, as ESG-related controversies lead to legal, reputational, and financial consequences (Shakil, 2021, Elamer and Boulhaga, 2024, Wu *et al.*, 2023). Effective environmental performance supports resilience, innovation and long-term value (Issa and Hanaysha, 2023; Yucel and Yucel, 2024).

Information quality plays a pivotal role by providing credibility and transparency regarding both human-capital management and environmental performance. High-quality financial reporting reduces information asymmetry, enhances investor confidence, and signals strong governance practices (Peng, 2024, Ayagi and Salisu, 2023). Recently, the European Union has considered scaling back its sustainability agenda by easing the requirements of the Corporate Sustainability Reporting Directive (CSRD). In this context, assessing how high-quality financial and non-financial disclosures affect corporate financial performance has become increasingly important (European Union, 2017).

The energy sector's performance has also been profoundly shaped by recent global shocks. The COVID-19 pandemic caused an unprecedented collapse in global energy demand due to lockdowns, reduced mobility, and temporary industrial shutdowns, which depressed revenues and raised operating costs (IEA, 2020). In contrast, the Russia–Ukraine conflict generated a severe supply shock that increase energy prices higher, amplified market volatility and revealed structural vulnerabilities -particularly for European energy firms reliant on Russian supplies- accelerating renewable-energy investments and reshaping long-term competitiveness (IEA, 2022). The present study examines a period that encompasses the financial effects of both shocks.

Human capital, environmental performance, and information quality have largely been studied in isolation, yet empirical evidence increasingly suggests that they operate in an interconnected manner. Human capital enhances financial and innovation outcomes (Buallay, 2019; Tran and Vo, 2020), environmental performance shapes operating costs and long-term firm value (Oestreich and Tsiakas, 2024; Gallego-Álvarez *et al.*, 2015), and high-quality disclosures reduce information asymmetry and build investor confidence (Bushman and Smith, 2001; Francis *et al.*, 2008). In the global energy sector these three dimensions reinforce one another: human capital drives innovation and the capacity to adopt low-carbon technologies (Crook *et al.*, 2011); environmental performance supports regulatory compliance and sustainability commitments (Hart and Dowell, 2011); and financial and non-financial reporting enhances transparency and facilitates access to capital (Christensen *et al.*, 2021). Their interaction provides a more complete explanation of financial performance than examining each dimension separately.

This study advances prior research in three ways. First, it integrates human capital, environmental capital, and information quality into a single model to analyze their combined impact on financial performance. Second, based on a multinational sample of 169 energy companies from more than 50 countries between 2016 and 2022, it provides robust and generalizable results across diverse institutional and cultural settings. Unlike previous works focusing on single-country analyses or developed markets, this study offers a broader perspective on the determinants of financial performance in the global energy industry. Third, it draws on Resource-Based Theory (RBT), Stakeholder Theory (ST), and Institutional Theory (IT) to develop a multi-level framework explaining how intangible resources, stakeholder relationships, and institutional environments jointly shape financial outcomes.

The empirical results indicate that professional training, efficient use of human capital, and fair compensation systems exert a strong and positive influence on financial

performance. Conversely, higher CO₂ emission intensity and ESG-related controversies are linked to weaker financial outcomes, while high-quality financial reporting enhances profitability. Moreover, the magnitude and direction of these effects vary between developed and developing countries.

Following the introduction, the next section outlines the theoretical framework and hypothesis development. Section three describes the data and methodology. Section four presents the empirical findings. Section five concludes with a discussion of the main findings, emphasizing their theoretical relevance, practical significance, and potential directions for future research.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEWS AND HYPOTHESIS

2.1 Theoretical Framework

Adopting a multi-theoretical perspective offers a stronger conceptual basis for explaining how human, environmental, and informational capital collectively influence the financial performance of firms in the energy sector. Our approach integrates three complementary perspectives -RBT, ST, and IT- to capture firm-level resources, stakeholder pressures, and institutional contexts as interdependent drivers of competitive advantage.

From a RBT perspective, firms achieve sustainable competitive advantages by deploying resources that are valuable, unique, difficult to imitate, and not easily replaceable (Surroca *et al.*, 2010). In the energy sector, human capital is valuable because technical expertise and green skills enhance operational adaptability and innovation; these capabilities are rare and costly to replicate given the industry's high technological complexity. Environmental capital is rare and strategically valuable in regulated markets, transforming compliance obligations into sources of differentiation. Informational capital, embodied in transparent reporting and credible ESG disclosures, is inimitable and non-substitutable because investor trust and corporate reputation are built cumulatively and cannot be reproduced through short-term actions. Together, these intangible resources form the internal foundation for superior performance, yet their financial impact depends on how firms interact with external stakeholders.

ST explains the transmission mechanisms linking internal resources to financial outcomes. Human, environmental, and informational capital generate value when firms effectively manage relationships with employees, customers, investors, regulators, and society at large. Stakeholder engagement and accountability strengthen legitimacy, lower perceived risk, and thus reduce the cost of capital while expanding access to financing and market opportunities (Talbot *et al.*, 2021). Conversely, weak stakeholder management can trigger regulatory scrutiny, activist campaigns, or reputational damage, undermining the financial returns of otherwise strong internal capabilities. Hence, stakeholder relationships act as the conduit through which intangible resources translate into measurable financial performance.

The financial performance of energy sector firms is strongly shaped by the institutional

environment in which they operate, encompassing formal rules (laws, regulations), informal norms, and societal values. IT posits that these external institutions act as structural determinants of firm outcomes. High-quality institutions (characterized by legal certainty, regulatory effectiveness, and transparent governance) create conditions under which firms can effectively deploy their human, environmental, and informational capital, build stakeholder trust, and secure resources. In strong institutional contexts, energy firms are better positioned to reduce transaction costs, navigate regulatory requirements, and access long-term financing, leading to superior financial performance. Empirical evidence supports this view: Almawi and Ülgen (2024) demonstrate that sustainable energy transitions require robust institutional conditions to enable green investments, while Bellemare (2024) shows that firms operating in higher-quality institutional environments achieve stronger performance in the oil and gas sector.

The integration of RBT, ST, and IT offers a multi-level framework for understanding financial performance in the energy sector. RBT emphasizes firm-specific resources as sources of competitive advantage, ST explains how these resources generate outcomes through stakeholder relationships, and IT situates both resources and stakeholder interactions within the institutional environment that shapes strategic opportunities.

2.2 Literature Review and Hypotheses

2.2.1 Human Capital and Firm Performance

Human capital is a fundamental determinant of organizational financial performance, as the skills, knowledge, and capabilities of employees increasingly represent a core driver of sustainable competitiveness (Nimtrakoon, 2015). Effective human resource management enhances operational efficiency, fosters innovation, and contributes to long-term strategic positioning, particularly in technologically intensive sectors such energy (Rahim *et al.*, 2017).

Empirical evidence from developed economies consistently supports this relationship. Parham and Heling (2015) found that Human Capital Efficiency (HCE) exerts a positive impact on ROA, ROE, and employee productivity in Dutch manufacturing firms. Similarly, Chen *et al.* (2005) find that intellectual capital investment in Taiwanese listed companies significantly enhances market value and profitability. Clarke *et al.* (2011) document both direct and lagged effects of human and structural capital on the performance of Australian firms, while Galeão *et al.* (2024) report that HCE exerts the strongest positive impact on ROA and ROE among the 50 largest Portuguese companies. Nadeem *et al.* (2018), using a sample of 571 listed Australian firms, further confirm that intellectual capital efficiency contributes positively to ROA and ROE, consistent with both RBT and ST.

Evidence from emerging economies shows similar patterns. Buallay (2019), finds that human capital efficiency plays a central role in supporting financial performance among Gulf region banks operating under less mature institutional conditions. Weqar *et al.* (2024) reveal that HCE positively influences financial sustainability in India's wind energy companies, Tran and Vo (2020) report a positive association between HCE, operational efficiency, and

financial performance in Vietnamese energy companies using the VAIC methodology. Within the framework of RBT, these findings illustrate that human capital constitutes a valuable and difficult-to-imitable resource that enhances competitive advantage. From a ST perspective, employee competence and cohesion enhance trust and legitimacy among investors, regulators and other stakeholders.

Hypothesis I: *Human Capital Efficiency (HCE) is positively associated with the financial performance of energy companies.*

Training and development (T&D) of human capital have a direct impact on organizational productivity and profitability, as they reduce employee turnover and enhance commitment (Aleem and Bowra, 2020). Thoresen *et al.* (2004) identify development-oriented training as a factor that fosters a sense of belonging, boosts morale and productivity, and reduces recruitment costs. These elements underpin long-term competitiveness in the energy sector, which demands high levels of technical specialization and strict regulatory compliance (Tran and Vo, 2020).

In the context of transition toward renewable energy sources, T&D also becomes essential for addressing emerging skill requirements. A lack of adequately trained human resources is one of the main barriers to the development of renewable energy projects (Lucas *et al.*, 2018). Training programs therefore play a crucial role in the effective utilization of human assets, improving job satisfaction, and enhancing financial performance. Sectors characterized by rapid technological change, such as the energy, require continuous employee development to build adaptability and meet evolving market needs (Quartey, 2012). Moreover, green talent management supports the adoption of environmentally sustainable practices within energy companies (Vardarlier and Türk, 2022).

Empirical research consistently highlights the contribution of T&D to firm performance. Rahman and Akhter (2021) show that investments in employee training and skill development improve operational outcomes. Díaz-Fernandez *et al.* (2015) identify firm-specific training as a key determinant of performance and innovation, while Manresa *et al.* (2019) demonstrate that training focused on creativity and innovation strengthens a firm's capacity to develop new products and services.

From a ST perspective, investing in professional development strengthens relationships with internal and external stakeholders. From a RBT perspective, well-developed human capital constitutes a valuable and unique resource that enhances organizational adaptability and innovation capacity in dynamic energy markets. Together, these insights suggest that T&D contributes directly to superior financial performance. Therefore, based on previous research, we propose the following hypothesis:

Hypothesis II: *Training and Development (PD) is positively associated with the financial performance of energy companies.*

Pollution-intense industries exhibit substantial remuneration differentials between executives and non-executive employees (Ho *et al.*, 2024). Relative Deprivation Theory

suggests that an excessive internal pay gap can lead to feelings of exploitation among employees and have negative effects on organizational growth (Xie *et al.*, 2024). Overall, the extant literature indicates that while certain wage disparities may be justified and even foster productivity and motivation, excessive disparities can undermine employee trust in corporate leadership. This erosion of trust has been linked to lower levels of employee commitment, morale, and job satisfaction, as well as higher turnover rates and reduced team cohesion, all of which negatively affect productivity innovation and financial performance (Osiichuk, 2022; Przychodzen and Gómez-Bezares, 2021; Shah *et al.*, 2024; Wang and Lin, 2024).

These findings highlight the critical importance of implementing equitable compensation structures to promote organizational effectiveness and employee satisfaction. Excessive pay gaps between executives and employees can reduce morale, trust, and organizational commitment. From a ST perspective, fair compensation strengthens employee relationships and organizational legitimacy, while the RBV emphasizes that a motivated workforce constitutes a valuable and strategic resource. Overall, large salary disparities undermine this critical human capital and negatively affect financial performance, leading us to propose the following hypothesis:

Hypothesis III: *Excessive CEO-employee pay gaps are negatively associated with the financial performance of energy companies.*

2.2.2 Environmental Capital and Firm Performance

Elevated CO₂ emissions levels expose energy firms to a broad spectrum of financial risks. Stricter environmental regulations and carbon pricing mechanisms increase compliance and operational costs, reducing profitability (Krueger *et al.*, 2020). Carbon-intensive companies also face reputational penalties and more restricted access to financing as stakeholders increasingly demand stronger environmental performance (Bose *et al.*, 2021). Moreover, high emissions also heighten vulnerability to climate-related disruptions, such as resource scarcity and physical damages, which threaten financial stability (Dietz *et al.*, 2016).

Although a substantial body of research has examined this relationship, the empirical evidence remains inconclusive. Most studies report a negative association between carbon risk and financial outcomes (e.g. Al-Fakir Al Rabab'a *et al.*, 2024; Busch and Lewandowski, 2017; Gallego-Álvarez *et al.*, 2015; Ibishova *et al.*, 2024; Le and Nguyen-Phung, 2024). However, other research documents a positive relationship (Busch *et al.*, 2022; Misani and Pogutz, 2015), and Trumpp and Guenther (2017) identify a non-linear (U-shaped) association between emissions and profitability. These inconsistencies primarily arise from regulatory heterogeneity across countries, firm-specific attributes, and differences in emissions measurement. Stricter regulations may increase compliance costs yet also stimulate innovation and efficiency. Larger firms typically possess greater resources to manage and disclose emissions, while studies differ in evaluating direct (Scope 1), indirect (Scope 2 or 3), or intensity-based emissions -each influencing both the interpretation and magnitude of financial impacts.

High carbon emissions often lead to financial penalties driven by regulatory pressure and stakeholder expectations, whereas low-emission capabilities constitute scarce and difficult-

to-imitate resources that provide competitive advantage. From a ST perspective, environmentally efficient practices reduce scrutiny from regulators, investors, and consumers, protecting firm legitimacy. From a RBT perspective, low-carbon technologies and environmental capabilities function as strategic resources that enhance efficiency, innovation, and long-term profitability. Together, these perspectives suggest that managing emissions strategically is closely link to superior financial performance.

Therefore, it is essential to determine whether reductions in carbon emissions influence financial outcome in the energy sector, and we propose the following hypothesis:

Hypothesis IV: *CO₂ emissions are negatively associated with the financial performance of energy companies.*

Controversies related to ESG issues can significantly diminish a company's value. Specifically, ESG-related environmental often lead to substantial legal costs and penalties, which sharply increase operating expenses (Bang *et al.*, 2023). Such events also erode consumer trust and brand equity - intangible assets that are critical for long-term success (Klein and Dawar, 2004). The resulting destruction of intangible and financial assets can trigger a cascading effect, including reduced market presence and a higher cost of capital, thereby posing serious risks to long-term profitability and survival (Sklenarz *et al.*, 2024). Likewise, insufficient transparency and inadequate attention to ESG matters undermine financial stability over time (Etim *et al.*, 2022).

Numerous studies have examine the impact of ESG controversies on firm value (Bang *et al.*, 2023; Dorfleitner *et al.*, 2020; Elamer and Boulhaga, 2024; García-Amate *et al.*, 2023; Kim *et al.*, 2025; Shakil, 2021), collectively demonstrating a negative relationship between controversy exposure and firm performance. These findings are consistent with Jucá *et al.* (2024), who show that ESG controversies exert a detrimental effect on corporate financial performance, particularly among firms operating in environmentally sensitive sectors, such as energy, and in companies based in developed economies.

ESG controversies undermine firm legitimacy, trust, and stakeholder confidence, often resulting in litigation costs, regulatory penalties, and reputational damage. From a ST perspective, such controversies erode relationships with investors, consumers, and other key stakeholders, reducing financial performance. Simultaneously, the RBV highlights that corporate reputation and effective ESG management are strategic intangible resources; when compromised, they diminish a firm's competitive advantage and value-creation capacity. Together, these perspectives suggest that ESG controversies negatively affect financial outcomes. Therefore, we propose the following hypothesis:

Hypothesis V: *ESG-related controversies are negatively associated with the financial performance of energy companies.*

2.2.3 Quality of Accounting Information and Firm Performance

Information asymmetry between internal and external stakeholders, combined with limitations in auditing practices and the discretionary nature of accrual accounting, creates

conditions under which reported earnings may deviate from a company's actual financial position. High-quality financial reporting is therefore essential to reducing information asymmetry and improving their stakeholder decision-making. Transparent and reliable disclosures enable investors and managers to make more informed assessments, strengthening market confidence (Luo and Bhattacharya, 2006). In addition, the quality of accounting information mitigates agency conflicts between shareholders, creditors and managers by fostering greater alignment of interests (Bushman and Smith, 2001; Wang, 2006).

High-quality reporting enhances corporate reputation and contributes to improved financial performance (Dong *et al.*, 2016), as reliable financial information provides more accurate insights into firm outcomes and reduces stock price volatility (Dechow *et al.*, 2010). Prior literature confirms that firms with higher earnings quality tend to receive more favorable ratings and experience reduced information asymmetry (Bhattacharya *et al.*, 2013). Several studies document economic benefits associated with improved earnings quality, including lower costs of capital and debt (Francis *et al.*, 2008), higher market valuation (Petroni *et al.*, 2000), and superior long-term financial performance (Burcă *et al.*, 2024; Duarte *et al.*, 2022).

Evidence from the energy sector further supports this relationship. For instance, firms in Nigeria's oil and gas sector exhibit improved performance when accounting information quality is high (Macgregor and Ibanichuka, 2021), while in Vietnamese energy firms, real earnings management temporarily enhances financial results (Khuong *et al.*, 2019).

High-quality accounting information plays a pivotal role in mitigating information asymmetry, enhancing transparency, and strengthening trust among investors, regulators, and other key stakeholders. From a ST perspective, transparent reporting improves legitimacy and facilitates better decision-making. From an RBV perspective, the capability to produce accurate, reliable, and timely financial information is a valuable and difficult-to-imitate resource that reduces financial risk and supports competitive advantage. Together, these perspectives suggest that accounting information quality positively influences financial performance. Therefore, we propose the following hypothesis:

Hypothesis VI: *Information quality is positively associated with the financial performance of energy companies.*

3. RESEARCH DESIGN

3.1 Data

To perform the sample selection, we include all companies classified within the energy sector in the London Stock Exchange Group's (LSEG) Data and Analytics database, formerly Refinitiv (Thomson Reuters). In order to select the sample, our analysis was confined to firms that were listed and reported their ESG scores and the variables necessary to compute the value-added intellectual coefficient (VAIC) are available on the LSEG platform. The final sample consist of 169 publicly listed energy companies operating in 50 countries between 2016 and 2022. Listed firms were chosen for their reliable, standardized international

reporting. The models do not have the same number of observations because some variables contain missing values.

The study begins in 2016, a year that marks the adoption of the UN Sustainable Development Goals, the Paris Agreement, and the introduction of the GRI G3 guidelines, all of which strengthened corporate sustainability reporting. This period additionally encompasses two major global disruptions, the COVID-19 pandemic and the Russia–Ukraine conflict, that significantly affected energy markets.

3.2 Variables

3.2.1 Dependent Variable

This study employs Gross Profit Margin (GPMargin) as its primary dependent variable, measuring profitability as the ratio of net operating income to operating costs. Higher GPMargin values indicate greater profitability and financial performance through effective cost management. GPMargin was chosen because it accurately reflects operational efficiency and core business performance, excluding financial or extraordinary effects, and is widely recognized as a reliable indicator of true economic profitability (Novy-Marx, 2013). It has been used in prior research to assess the impact of business strategies and environmental initiatives on financial outcomes (Jalalov and Bae, 2025). To complement GPMargin, Return on Assets (ROA) is also employed in robustness checks. ROA, a widely used measure, relates net income to total assets, capturing operational efficiency and providing an additional perspective to validate and strengthen the consistency of the results (Tran and Vo, 2020).

3.2.2 Independent Variables

Human Capital

Human Capital Efficiency (HCE). While taking value-added intellectual coefficient (VAIC) into account, we have focused on value-added human capital. HCE measures how much an organization is leveraging its human capital to generate value. It is calculated through the formula:

$$HCE = \frac{ValueAdded}{Human\ capital}$$

Value Added is attained by adding salary expense and compensation to EBITDA (Iazzolino and Laise, 2013). Human capital is measured based on total employee costs. A higher Human Capital Efficiency (HCE) indicates that a company is effectively leveraging its workforce to drive productivity and overall performance. This metric is especially relevant in the energy sector, where technological advancements and expertise are key drivers of competitiveness. Moreover, it has been widely used in prior research (e.g. Tran and Vo, 2020; Weqar *et al.*, 2024).

Professional Development (PD) measures the company's investment in training and development initiatives, ranging from 0 to 100%. The closer the value is to 100%, the higher the company's investment in professional development. This variable is measured according to

Refinitiv (LSEG) methodology, which defines the indicator as the ratio of total training and development expenses to total operating expenses, expressed as a percentage. This expenditure-based measure captures the intensity of firms' investment in enhancing workforce skills and professional development. By focusing on financial allocations rather than the number of employees trained, PD provides a standardized and comparable metric of human capital investment across firms.

While human capital efficiency (HCE), measured through VAIC, reflects the productivity and effectiveness of existing human resources in generating value added, training and development (PD) captures managerial investments in workforce capacity-building. Thus, PD is input-oriented, focusing on the extent of resources devoted to skill enhancement and employee development, whereas HCE is outcome-oriented, reflecting realized efficiency at the organizational level. Following Buallay (2019) and Al Frijat and Elamer (2025), we consider both variables to be complementary but distinct: PD signals strategic commitment to human capital formation, while HCE captures the actual economic contribution of human capital to firm performance.

Salary Gap (Salary Gap) is utilized to quantify the pay difference between the CEO and the median employee. A large gap can indicate internal inequalities, which can negatively impact employee morale, productivity, and overall organizational cohesion. Large wage differentials have been found to lead to worse firm performance through the loss of employee trust and commitment (Przychodzen and Gómez-Bezares, 2021).

Environmental Capital

CO₂ Emissions (CO₂_INT). Prior research typically measures corporate carbon performance using either total emission levels or emission intensity. To better capture environmental efficiency rather than production fluctuations, we measure firms' carbon performance using CO₂ emission intensity, defined as total CO₂ emissions (Scope 1 and 2) divided by net sales. This methodological approach is consistent with recent empirical research in the energy sector, which emphasize intensity-based indicators to assess firms' decarbonization and efficiency (Oestreich and Tsiakas, 2024). By scaling emissions by revenue, this measure enables comparability across firms of different sizes and reduces sensitivity to short-term output volatility.

ESG Controversies (ESG_Con) quantifies the extent of a company's exposure to ESG controversy. This is expressed as a percentage, and the higher values represent fewer controversies, reflecting stronger ESG performance, whereas lower values indicate a greater incidence of ESG-related controversies (according to the LSEG database methodology). To avoid ambiguity, we explicitly adopt this interpretation in the empirical analysis, where a positive association with financial performance reflects the beneficial effect of fewer controversies. The ESG controversy score is based on negative news coverage, such as lawsuits, fines, and regulatory scandals, and is widely used in research to quantify the impact of ESG policies on firm performance (Dorfleitner *et al.*, 2020; Shakil, 2021).

Information Quality

Earnings quality (EQ) has been widely employed as a proxy measure of accounting information quality (e.g. Boachie and Mensah, 2022; Behl *et al.*, 2022), which is "the degree to which historical earnings are reliable and more likely to persist" (LSEG, 2022). High-quality earnings suggest that the earnings reflect the firm's true financial health and will be maintained in the future. This study uses the LSEG database's StarMine Earnings Quality Model, which utilizes a quantitative multi-factor approach to predict earnings persistence, with a focus on accrual adjustments, cash flow generation, operating efficiency, revenue recognition, and indicators of management manipulation. These metrics are adjusted to account for the distinctive characteristics of each industry, as evaluations are conducted relative to sector-specific benchmarks that reflect the structural differences inherent to each industry. High-quality financial information mitigates information asymmetry, enhances investor confidence, and facilitates capital access, serving as a key proxy for information capital in the baseline analysis. The increasing importance of material non-financial information, particularly ESG disclosures, reflects heightened stakeholder scrutiny of firms' environmental and social impacts. To capture this dimension, robustness checks incorporate non-financial reporting practices, allowing comparison with financial reporting quality and reinforcing the validity of the findings. This approach underscores the significance of both financial and non-financial disclosures as essential components of information capital in the global energy sector.

Control variables

Based on previous research on the topic, we employed leverage, capital expenditures, firm size, and family firm ownership as *control variables*. According to prior research (Makridou *et al.*, 2024), firm leverage (Lev) was defined as total debt divided by total assets. Similarly, capital expenditure (LnCapex), was defined as the natural log of capital expenditure, which is a firm's investment in fixed and intangible assets (Moussa and Elmarzouky 2023). Firm size (Size) was determined as the natural logarithm of total assets (Weqar *et al.*, 2024). Family_Sh is a dummy for family control. For energy companies, family businesses can place long-term survival ahead of short-term gain (Watkins, 2018).

As for the macroeconomic factors, GDP Growth Rate (GDP), reflects the overall economic environment in which the firm operates (Klein and Weill; 2022), Inflation, measures the impact of price changes on firm performance, Human Development Index (HDI), indicates the level of social and economic development in the nation where the company conducts business (Yilmaz, 2021) and Legal System¹ (Civil_Com) is a dummy variable indicating if the company operates under a civil law regime, which may affect governance practices and regulatory compliance (Singh and Jaiwani, 2024).

3.3 EMPIRICAL RESULTS AND DISCUSSION

3.3.1 Reference Model

The study uses the following econometric model to estimate the impact of human capital, environmental capital, and accounting information quality on Gross Profit Margin:

¹ Civil or Common Law.

$$\text{GPMargin}_{it} = \alpha + \beta_1 \text{HCE}_{i,t} + \beta_2 \text{PD}_{i,t} + \beta_3 \text{Salary_Gap}_{i,t} + \beta_4 \text{CO2_INT}_{i,t} + \beta_5 \text{ESG_Con}_{i,t} \\ + \beta_6 \text{LNTA}_{i,t} + \beta_7 \text{EQ}_{i,t} + \beta_8 \text{Controls}_{i,t} + \eta \text{Year}_t + \delta \text{Industry}_i + \varepsilon_{it}$$

where GPMargin_{it} is a measure of the Gross Profit of a firm i in year t and $\text{HCE}_{i,t}$ is a measure of Human Capital Efficiency; $\text{PD}_{i,t}$ is a measure of a firm's investment in employee training and development programs, $\text{Salary_Gap}_{i,t}$ is the pay gap between the CEO and the median employee, $\text{CO2_INT}_{i,t}$ is a measure of the carbon risk, total CO₂ emissions by net sales; $\text{ESG_Con}_{i,t}$ is the ESG controversy score and $\text{EQ}_{i,t}$ is the Earnings Quality score. $\text{Controls}_{i,t}$ is a vector of control variables. Year_t is a year dummy vector (from 2016 and 2022); Industry_i signifies the fixed-effect control of the industry, and ε_{it} is the random disturbance. α , β 's, η and δ are the parameters which were to be estimated.

Methodologically, we employ a random-effects generalized least squares (RE GLS) model with year and industry fixed effects. This specification is appropriate for our unbalanced panel, which includes a substantial number of missing observations due to the lack of data for some explanatory variables. Additionally, several independent variables are time-invariant or exhibit very limited within-firm variation, meaning that using fixed effects would drop these variables and further reduce the sample size. As discussed by Wooldridge (2010), the random-effects approach efficiently exploits both the cross-sectional and time-series dimensions of the data, minimizing information loss while allowing for more stable and interpretable estimates.

4. Results and Discussion

4.1 Descriptive Analysis

The firm-level data were winsorized at the 2.5th and 97.5th percentiles to mitigate the influence of extreme values; Table 1 presents descriptive statistics for the full sample, covering all dependent and independent variables used in the principal analyses and robustness checks. The principal dependent variable, gross profit margin (GPMargin , %), exhibits a mean of 20.81 and a standard deviation of 67.52. Among the key independent variables, human capital efficiency (HCE) has a mean of 6.11—substantially higher than the 4.86 reported by Behl *et al.* (2022)—which likely reflects the broader multinational composition of our sample and the attendant heterogeneity in organizational practices and resource allocation.

Workforce-related indicators show a mean PD score of 34.94% and a mean Salary_Gap of 44.18% ($\text{SD} = 107.64$). The average ESG Controversies Score is 90.70%, while CO2_INT averages 1.49; these ESG controversy levels are broadly consistent with the 85% reported for European firms by Suciu *et al.* (2020). Concerning accounting information quality, the sample's average earnings quality (EQ) is 50.26%. This is somewhat lower than the EQ of 57.31% reported by Rahman *et al.* (2024) using comparable LSEG metrics (similar variability: $\text{SD} \approx 27.24\%$), yet markedly higher than the 33.24% found by Asimakopoulos *et al.* (2023). We attribute these discrepancies principally to sample composition: our dataset's larger, multinational energy firms likely exhibit stronger reporting standards and greater international exposure than the smaller, domestically focused Greek firms examined by Asimakopoulos *et al.* (2023).

INSERT TABLE 1

The correlation matrix presented in Table 2 shows generally low values, indicating the absence of strong linear relationships among the independent variables. This implies that multicollinearity is unlikely to pose a significant problem. To further verify this assumption, a Variance Inflation Factor (VIF) test can be performed to confirm the absence of multicollinearity concerns.

INSERT TABLE 2

4.2 MULTIVARIATE ANALYSIS

Table 3 shows the results of our regression models, which examine the effects of different factors on the GPMargin of energy companies. Model 1 examines the effect of the independent and firm control variables on the dependent variable, GPMargin. Model 2 introduces the macroeconomic variables, GDP Growth Rate, Inflation, Human Development Index, and Legal System. Model 3 introduces year and industry-fixed effects.

INSERT TABLE 3

4.2.1 Human Capital and Financial Performance

The analysis reveals in Table (3) a positive and significant relation between HCE and GPMargin. These results validate Hypothesis I, human capital effectiveness positively impacts financial performance. This aligns with the findings of Chen *et al.* (2005), Clarke *et al.* (2011), Galeão *et al.* (2024), and Buallay (2019), who emphasize that effective human resource management enhances operational efficiency and profitability across different economic sectors and institutional contexts. Additionally, studies such as Tran and Vo (2020), who found this relationship in the wind energy sector in Vietnam, and Weqar *et al.* (2024), who reported a significant impact of human capital effectiveness in Indian wind power companies, also support this result.

Similarly, there is a positive relation between professional training and GPMargin, confirming Hypothesis II. Our results are in line with Díaz-Fernandez *et al.* (2015), Manresa *et al.* (2019), and Quartey's (2012) who argued that investments in employee training and development enhance productivity and innovation, leading to better financial outcomes. The positive impact of professional training can also be seen in studies like Aleem and Bowra (2020), Rahman and Akhter (2021), and Thoresen *et al.* (2004), which all refer to the importance of systematic training in restricting turnover, improving job satisfaction, and increasing profitability.

Regarding differentials in wages, there is the negative and significant relationship between CEO-employee wage gaps and GPMargin. Hypotheses III and the Relative Deprivation Theory are therefore supported by our findings. Consistent with prior research (Osiichuk, 2022; Przychodzen and Gómez-Bezares, 2021; Shah *et al.* 2024; Wang and Lin, 2024), excessively large pay gaps

negatively impact employee morale, commitment, and job satisfaction, ultimately weakening organizational cohesion. While good corporate governance enhances firm value, it can also exacerbate wage inequalities, leading to negative financial consequences. Martono *et al.* (2022) suggest that while moderate pay differences may benefit financial performance, excessively large disparities, particularly at the executive level, disrupt communication and cooperation, ultimately resulting in financial inefficiencies.

4.2.2. Environmental Capital and Financial Performance

The empirical results of the research provide a strong and negative relationship between profitability and carbon emission intensity, confirm Hypothesis IV. This is also asserted by Al-Fakir Al Rabab'a *et al.* (2024), Busch and Lewandowski (2017), Gallego-Álvarez *et al.* (2015), Ibishova *et al.* (2024), and Le and Nguyen-Phung (2024), who demonstrate that carbon risks not only increase operating costs but also destabilize financial performance. Our findings contrast with prior evidence indicating a positive relationship (Busch *et al.*, 2022; Misani and Pogutz, 2015).

Our findings reveal a strong positive correlation between ESG controversy scores and financial performance, supporting Hypothesis V. Companies entangled in ESG scandals and governance issues tend to experience poor financial performance, consistent with prior research by Bang *et al.* (2023), Dorfleitner *et al.* (2020), Elamer and Boulhaga (2024), García-Amate *et al.* (2023), Kim *et al.* (2025), and Shakil (2021). These studies highlight that ESG controversies result in reputational damage, regulatory scrutiny, and loss of investor confidence, all of which contribute to financial underperformance. Specifically, Jucá *et al.* (2024) found that ESG controversies have a particularly severe negative impact on firms operating in environmentally sensitive industries, with the energy sector being the most affected.

4.2.3 Accounting Information Quality and Financial Performance

The analysis reveals a positive and significant relationship between earnings quality (EQ) and GPMargin, confirming that high-quality financial reporting enhances financial performance and supporting Hypothesis VI. This finding aligns with prior research by Dong *et al.* (2016) and Duarte *et al.* (2022), which demonstrates that transparent financial disclosures contribute to stronger financial outcomes. In the energy sector, similar evidence is reported by Macgregor and Ibanichuka (2021) and Khuong *et al.* (2019), reinforcing the link between accounting transparency and profitability. Furthermore, Bushman and Smith (2001) and Wang (2006) highlight that high-quality earnings reports help limit information asymmetry and lessen agency conflicts between managers and shareholders, ultimately fostering improved financial performance, a conclusion strongly reinforced by this study.

The findings highlight the critical role of managerial decisions regarding earnings management in sustaining firms' financial resilience. This underscores the need for stronger corporate governance frameworks and the implementation of more effective and high-quality regulatory and institutional mechanisms.

4.3 Robustness and Complementary Analysis

4.3.1 Robustness check

Additionally, as a robustness check, we use ROA as an alternative measure of the dependent variable for financial performance (Tran and Vo, 2020). Regarding the independent variables related to human capital, we employ the VAIC as an alternative measure of human capital

efficiency. To assess the company's overall commitment to its employees, we used the Workforce subdimension of the social score. We include diversity and inclusion indicators, recognizing the growing body of research highlighting the significant impact of these effective human capital management practices on corporate performance (Suárez-Fernández *et al.*, 2024).

With respect to environmental capital, we use the environmental score as an alternative measure, and in relation to the quality of accounting information, we include the preparation of non-financial reports (CSR_Report) by companies as a proxy for information quality (Christensen *et al.*, 2021; Etim *et al.*, 2022). Both variables are obtained from the LSEG database. CSR_Report is a dummy variable that takes the value 1 when a CSR or sustainability report is published, and 0 otherwise.

The results regarding VAIC and non-financial reporting are statistically significant (see table 4). However, the Workforce subdimension score does not show a statistically significant effect. Moreover, a stronger focus on diversity and inclusion policies does not necessarily lead to better financial performance; in some cases, these diversity policies may even negatively impact ROA. In this regard, Beraki *et al.* (2022) highlights the complexity of the relationship between diversity and financial efficiency, noting that greater female representation may initially increase operational costs and require capacity-building efforts. However, despite these challenges, gender diversity remains essential for fostering more inclusive governance structures (Baker *et al.*, 2021).

However, no statistically significant relationship is found between the ESG score and ROA, consistent with previous findings (e.g., Baran *et al.*, 2022). This outcome may stem from the nature of the ESG score, which is a composite indicator reflecting firms' policies, disclosures, and risk management practices, and therefore exhibits limited within-firm variation. ESG scores, despite their growing adoption, face several limitations, including methodological opacity, and data quality issues, all of which undermine their overall reliability (Sahin *et al.*, 2023). In contrast, carbon intensity is an operational and outcome-based measure that more directly captures firms' productive and environmental performance within the energy sector.

INSERT TABLE 4

Finally, the robustness of the main findings is evaluated using alternative estimation approaches. In particular, a pooled OLS model incorporating year and industry fixed effects with robust standard errors was estimated, producing results consistent with the baseline analysis².

4.3.2 Complementary analysis: developed versus developing countries

Previous research examining the relationship between human, environmental and informational capital and economic performance is mainly based in developed countries. Our primary analysis is conducted within an international framework, enabling a more comprehensive examination. To enhance the analysis further, countries are categorized as either developed or developing based on the criteria set forth by the United Nations³.

IT posits that external institutions serve as fundamental structures shaping corporate behavior and organizational outcomes. In developed economies, stronger regulatory enforcement,

² The results of the robustness tests are available upon request from the authors.

³ https://www.un.org/development/desa/dpad/document_gem/global-economic-monitoring-unit/world-economic-situation-and-prospects-wesp-report/

greater investor scrutiny, and normative pressures increase the financial relevance of transparent reporting and authentic sustainability practices.

The results presented in Table 5 show that for developed countries, the results are the same as for the full sample. However, in the case of developing countries, only HCE and the salary gap remain statistically significant, while all other variables show no significant effects. In other words, the effects of professional development, a high CO₂ emission, ESG controversy and earnings quality are only significant in developed countries.

Although the energy sector is becoming increasingly global as companies expand beyond their home countries, institutional differences between developed and developing nations remain significant (Gómez-Bolaños *et al.*, 2022). While financial globalization reduces the influence of national factors, home-country conditions still shape the relationship between Corporate Social Performance (CSP) and financial performance in energy companies. Our findings align with those of Naeem *et al.* (2022), who studied environmentally sensitive industries and found that firms in developing countries often engage in social and environmental initiatives primarily to comply with legal requirements.

Additionally, research from *MSCI ESG Ratings in Global Equity Markets: A Long-Term Performance Review* (MSCI, 2024) highlights a striking contrast in ESG performance across regions. In carbon-intensive sectors like energy, companies with stronger ESG ratings outperformed their peers in advanced economies. However, in emerging markets, the opposite was observed: firms with higher ESG ratings underperformed (MSCI, 2024). This disparity stems from the different stages of the fossil fuel transition. Many emerging economies remain heavily reliant on coal and continue to expand its use for power generation, even as they gradually integrate renewable energy sources (Shakdwipee *et al.*, 2024).

INSERT TABLE 5

5. CONCLUSIONS, LIMITATIONS, AND FUTURE RESEARCH DIRECTIONS

This study integrates Resource-Based, Stakeholder, and Institutional Theories to examine the combined effects of human capital, environmental capital, and information quality on the financial performance of 169 multinational energy firms during the period 2016–2022, contextualized within the global energy crisis and the accelerating transition toward a more sustainable energy system.

The results highlight the central role of human capital in shaping financial performance. Effective human-capital management, supported by strategic investment in employee training and development, is positively associated with profitability and long-term competitiveness. In contrast, excessive pay disparities, particularly between executives and median employees, undermine motivation and organizational cohesion, ultimately harming financial outcomes. The study also shows that the contribution of human capital management is especially pronounced in developing economies, a dimension that has been less explored in previous research.

Regarding environmental performance, the findings reveal a negative relationship between CO₂ emissions intensity and profitability, indicating that environmental inefficiency imposes hidden costs and erodes competitive positioning. Firms that fail to manage their carbon footprint face heightened operational risks, regulatory sanctions, and declining investor and consumer

confidence. ESG controversies likewise destroy firm value through both reputational and financial channels. However, these environmental effects are weaker in developing economies, where lower regulatory enforcement and limited investor activism reduce the financial materiality of environmental performance.

Information quality also emerges as a decisive factor in firm performance. High-quality financial and non-financial reporting enhances transparency, reduces information asymmetry, and strengthens market confidence. An effect magnified in the energy sector, where volatility and the uncertainties of the energy transition amplify the need for reliable information to guide investment and risk management decisions.

Taken together, these findings validate the integrated theoretical framework and suggest that combining strong human capital management, proactive environmental stewardship, and robust financial transparency is essential to achieving sustainable growth and long-term competitiveness. Companies that balance profitability with sustainability goals are better equipped to meet regulatory demands, respond to stakeholder expectations, and build enduring competitive advantage.

Although the energy sector operates within an increasingly globalized context, institutional differences between developed and developing countries persist. Home country characteristics continue to shape the impact of Corporate Social Performance (CSP) on financial performance. In developing countries, human capital investment remains a primary driver of productivity due to the relative scarcity of skilled labor, while in advanced economies, environmental performance receives closer scrutiny from investors, regulators and civil society.

This research offers meaningful implications for policymakers, investors, managers, and other stakeholders.

For managers, employee training and development should be treated as a strategic investment to strengthen human-capital efficiency and organizational resilience. Equitable compensation policies that reduce excessive wage disparities—particularly between executives and rank-and-file employees—can further enhance motivation, cohesion, and organizational stability. To address carbon-related risks, firms should pursue emissions reductions, implement clean-energy technologies, and ensure compliance with environmental regulation. Proactive management of ESG controversies—through fortified governance structures, enhanced stakeholder engagement, and consistent adherence to ESG standards—helps safeguard reputation and financial stability. High-quality financial reporting, complemented by consistent non-financial disclosures reinforces transparency, curbs managerial opportunism, and improves market valuation.

Stakeholders—including investors, analysts, and consumers—should recognize that firms that prioritizing sustainability, human-capital development, and transparency are increasingly linked to superior financial performance.

This study offers important policy and regulatory implications. Policymakers should promote measures that encourage carbon-emission reductions, human-capital investment, and enhanced disclosure quality. Stricter environmental regulations and green-innovation incentives can simultaneously foster sustainability and corporate performance. Carbon pricing instruments help internalize environmental costs, while mandatory assurance of ESG disclosures improves credibility and comparability. Additionally, tax incentives or training credits can accelerate workforce upskilling in competencies relevant to the energy transition (Lin and Lin, 2025).

Legislative initiatives aimed at limiting excessive pay disparities -for instance, capping CEO-to-median employee ratios- may further reduce inequality and strengthen workforce cohesion.

Despite its contributions, this study has certain limitations. First, it focuses exclusively on publicly listed energy companies, meaning the findings may not generalize to privately held firms or other industries with different structural dynamics. Second, the analysis covers the period from 2016 to 2022, which -although substantial- may not fully capture longer term trends or the effects of recent regulatory, technological or geopolitical developments (Jalalov and Bae, 2025).

Future research could address these limitations by including smaller companies and a broader set of industries, enhancing the generalizability of the results. Examining country or region specific regulatory and market conditions would also provide deeper insights into how local institutional environments moderate the relationships among human capital, environmental practices, information quality, and financial performance. In addition, exploring interactions with external factors such as regulatory stringency, economic cycles, and technological progress may yield a more comprehensive understanding of these mechanisms.

Finally, although the study assumes a unidirectional effect of human, environmental, and informational capital on financial performance, reverse causality may exist. More profitable firms may have greater capacity to invest in training, environmental initiatives, or disclosure quality, potentially biasing the estimated effects. While the methods employed mitigate this concern, they do not eliminate endogeneity entirely. Future studies could adopt more robust econometric techniques -such as System GMM, instrumental-variable approaches, structural equation modelling or non-linear frameworks (e.g., threshold or quantile models)- to better capture causal relationships. Causal identification strategies such as Difference-in-Differences or event-study designs would strengthen inference. Incorporating richer longitudinal data would also enhance the rigor and robustness of future analyses.

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